7-31-2015

Session C, 2015 Second Place: Habituation of Creek Chub to a Chemical Alarm Stimulus

Benjamin Kosalek

Zachary Davis

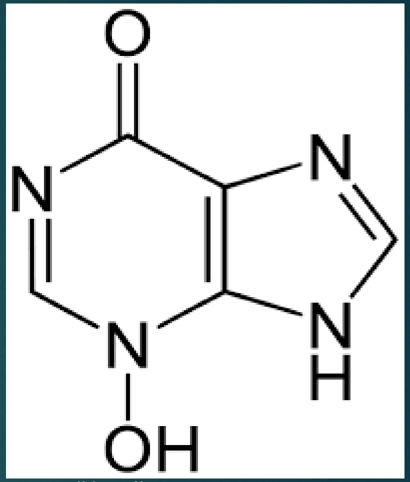
Habituation of Creek Chub to a Chemical Alarm Stimulus

ZACH M. DAVIS
BEN KOSALEK

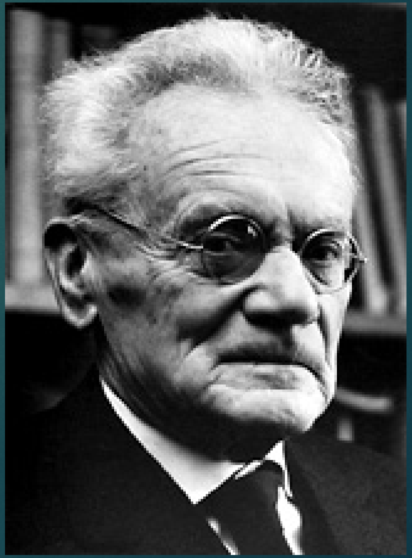
gallery.nanfa.org

Introduction

- One minnow freaks out, they all do
- Karl von Frisch (1938) coined the substance as Schreckstoff "Fear Stuff" (Stensmyr 2012)
  - Hypoxanthine-3N-oxide (H_3NO) (Parra 2009)
  - Ostariophysi superorder



en.wikipedia.org



www.nobelprize.org

Hypothesis

- If we expose Creek Chub (*Semotilus atromaculatus*) to a chemical alarm stimulus without there being any danger/predators, the creek chub will habituate to the stimulus and won't react
- Null Hypothesis: That the creek chub will not habituate to the chemical alarm stimulus

Methods

Courtesy of: Google Earth

Photo by: Ben Kosalek

Photo by: Ben Kosalek

Courtesy of: Google Earth

Method

- Control n=10
- Experimental

  n=10
- 10 for chemical

  alarm stimulus
- Surgical clamps = jaws of a predator

Photo by: Ben Kosalek

Photo by: Ben Kosalek

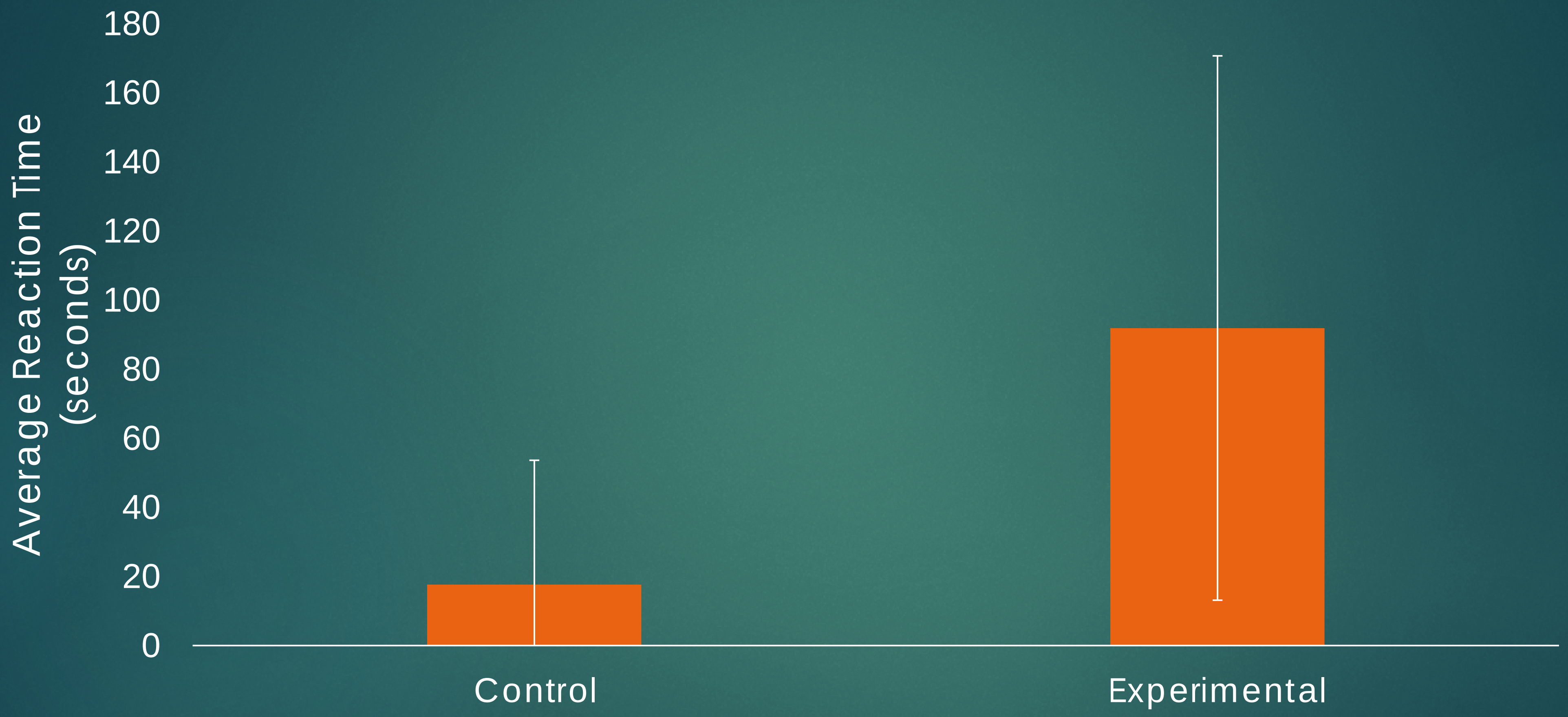
www.pjtool.com

Photo by: Ben Kosalek

Results

Videos by: Zach Davis

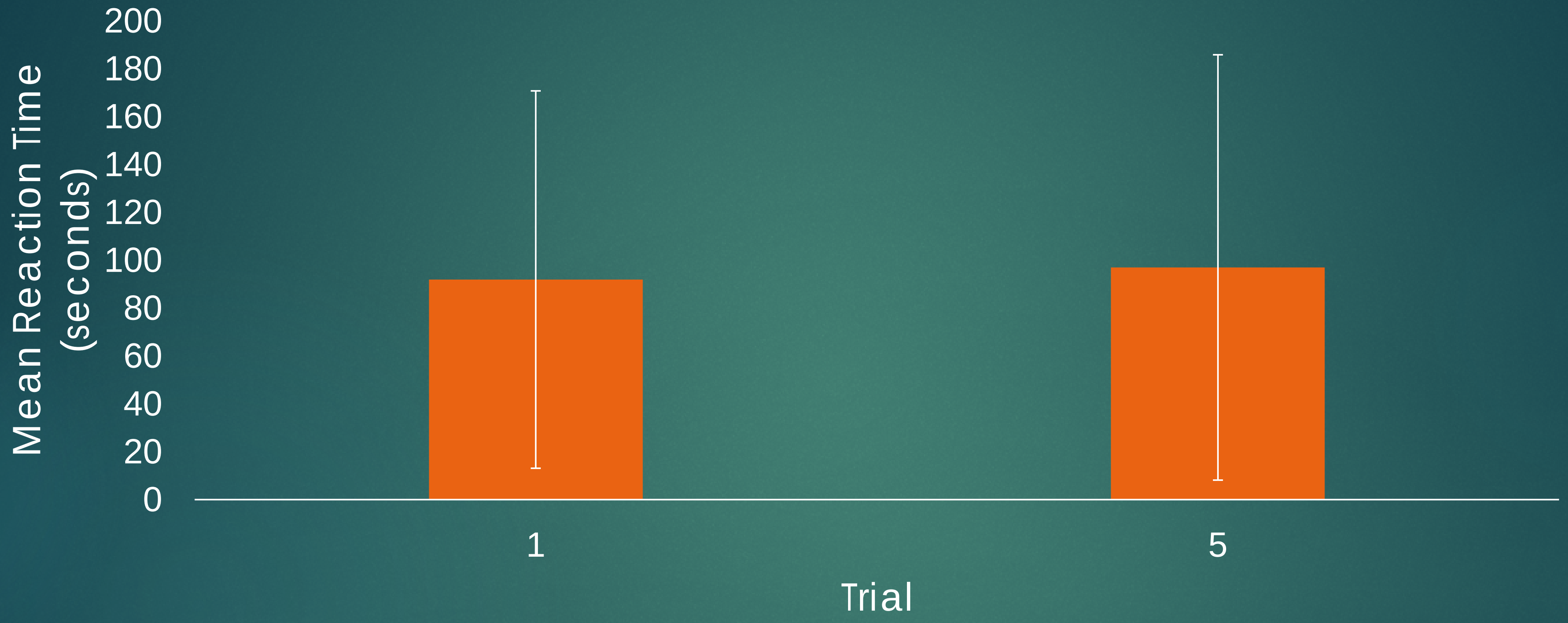
Control vs Experimental



T = -2.71
P = 0.019
n = 10

- Control significant from experimental

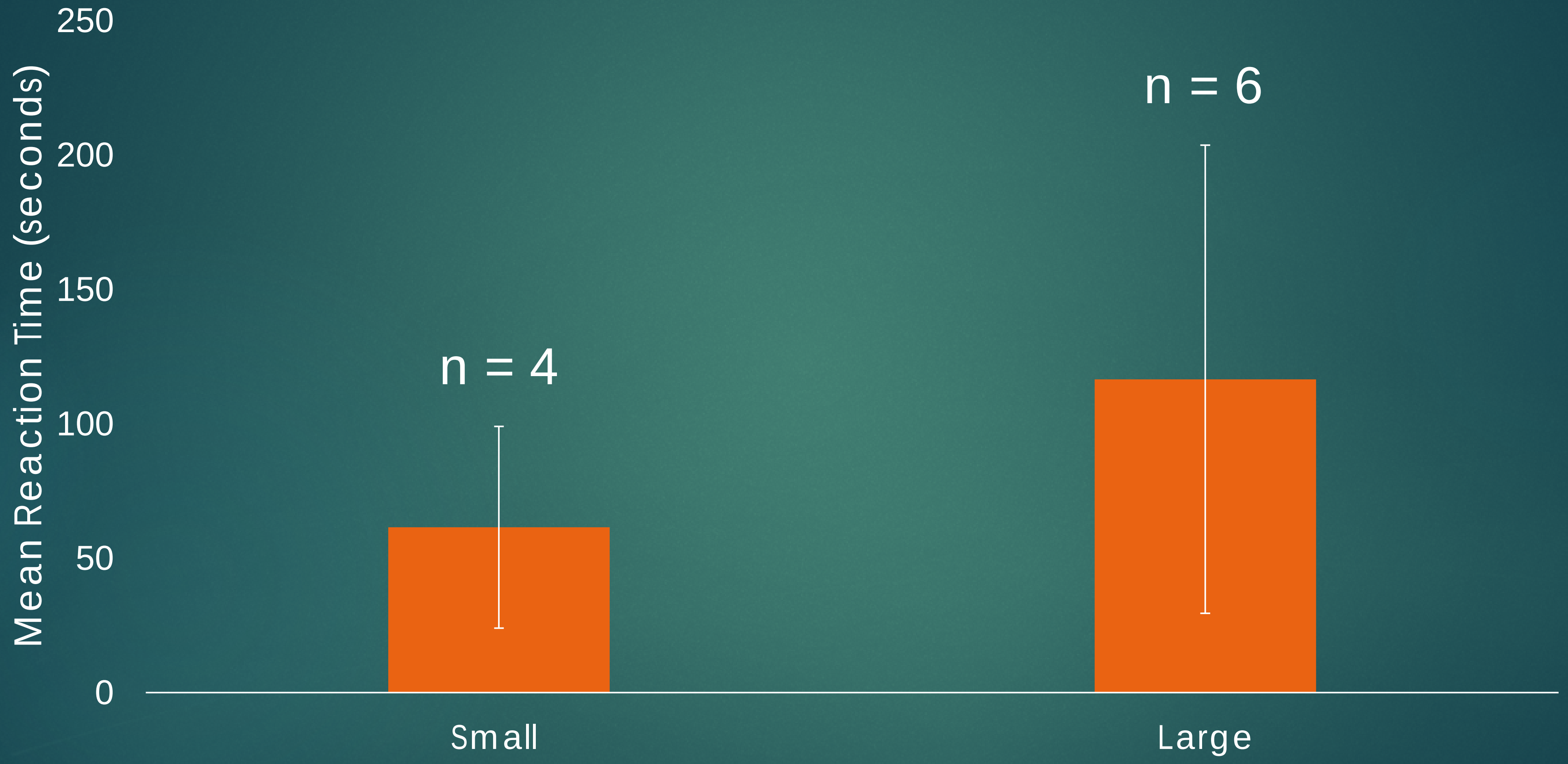
Trial 1 vs 5



T=-0.14
P=0.894
n=10

- Minnows did not show capacity to learn throughout the trials
- Did not support our hypothesis

Size Correlation



T = -0.92
P = 0.424

- Older minnows had longer reaction times

Discussion

- Innate behavior vital to survival(Chivers 1998)
- Size correlation appears to show that minnows learn to be more wary of the alarm stimulus
- Results confirm presence of chemical alarm stimulus shown in previous studies(Jung 2011, Speedie 2008)

Discussion Cont.

- Methods limited as to not cause undue stress to the minnows
  - Physically injuring minnows to extract alarm chemical
  - Only 5 trails per fish
- Couldn't obtain Hypoxanthine-3N-oxide (H_3NO)
- Couldn't obtain measurable concentration of alarm chemical

Follow-Up Studies

- Test different species of minnows
- Perform more trials per fish
- Further compare learning abilities between different age ranges

Why is this important?

- Intrinsic part of the food web
- Feed on many aquatic invertebrates and eaten by many upper trophic level predators

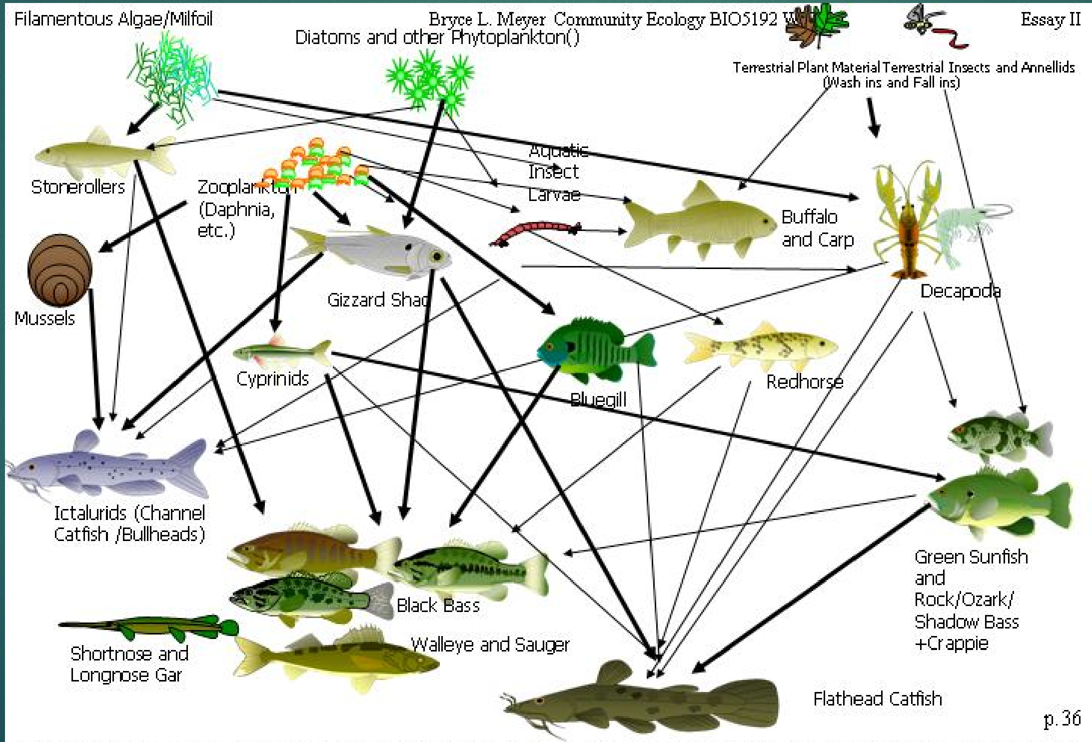


Figure #31: Simplified Food Web (Source Down) similar to warm water lower end of river before entry into Mississippi River System or impoundment. The Flathead acts as a super predator when present as large speciemens, and many predators such as walleyes and Gars compete for minnows and shad. Channel Catfish also appear and prey upon mussels and other invertebrates.

www.combat-fishing.com

Conclusion

- We found that Creek Chubs did not exhibit the ability to habituate to their chemical alarm signal and ignore it.

Acknowledgements

- SUNY ESF
- Cranberry Lake Biological Station
- Dr. Fiene
- Dr. Fierke
- Dr. McKenna
- Christopher Foelker

References

- Chivers, D. P., & Smith, R. J. F. (1998). Chemical alarm signalling in aquatic predator-prey systems: A review and prospectus. *Écoscience, 5*(3), 338-352.
- Jung, J. A., & Tonn, W. M. (2011). Alarm substances elicit limited population-level responses in fathead minnow. *Ecology of Freshwater Fish, 20*(2), 220-230. doi:10.1111/j.1600-0633.2010.00481.x
- Parra, K. V., Adrian Jr., J. C., & Gerlai, R. (2009). The synthetic substance hypoxanthine 3-N-oxide elicits alarm reactions in zebrafish (danio rerio). *Behavioural Brain Research, 205*(2), 336-341. doi:http://dx.doi.org/10.1016/j.bbr.2009.06.037
- Speedie, N., & Gerlai, R. (2008). Alarm substance induced behavioral responses in zebrafish (danio rerio). *Behavioural Brain Research, 188*(1), 168-177. doi:http://dx.doi.org/10.1016/j.bbr.2007.10.031
- Stensmyr, M., & Maderspacher, F. (2012). Pheromones: Fish fear factor. *Current Biology, 22*(6), R183-R186. doi:http://dx.doi.org/10.1016/j.cub.2012.02.025
- Webster, M. M., & Laland, K. N. (2008). Social learning strategies and predation risk: Minnows copy only when using private information would be costly. *Proceedings of the Royal Society of London B: Biological Sciences,275*(1653), 2869-2876. doi:10.1098/rspb.2008.0817

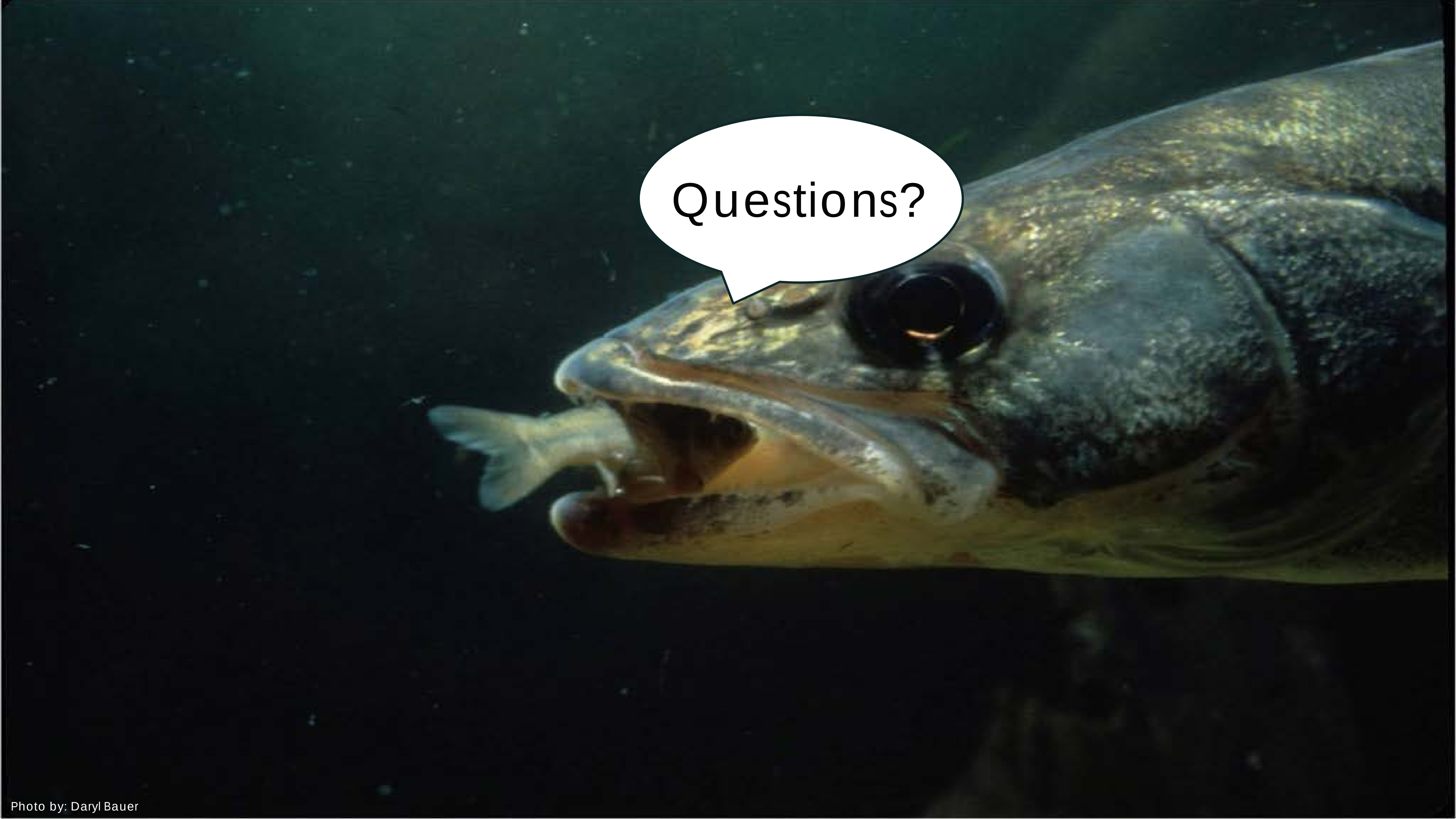


Photo by: Daryl Bauer